

therefore, Agathocles owed his escape on August 14 to the fact that he could sail instead of row. If so, his minimum pace would be seven knots, or otherwise he would have rowed, and the Carthaginians would perhaps have caught him. Again, we are ourselves convinced that Agathocles was expecting the appearance of the provision ships. It may be that he was merely prepared for any favourable opportunity, but there is much to prove that he laid his plans very carefully. He had, for instance, put saddles and bridles on board. He could not take horses with him, but he was prepared to use any he might capture on landing. On a subsequent occasion, thinking that the appearance of owls (as birds of good omen) would encourage his soldiers, he set some free, which he had evidently provided beforehand (Grote).

We have therefore established that by 8 a.m. on August 15 Agathocles had been at sea upwards of twenty-four hours, and that he started with a fair wind. He clearly did not stand out to sea more than was necessary, for to do so would be to abandon part of his start. The last and most important question is, therefore, did Agathocles go north or south?

Our third point is that Agathocles went north. Airy has already noted that the provision ships probably came from Gela, on the south coast of Sicily, since that was the only place still, after the battle of Himera two months previously, friendly to Agathocles (Grote). Airy also notes that even 330 miles is a short voyage for six days, and therefore that the longer course is more probable. Airy also makes a third point. "It is stated by Diodorus that the troops before sailing supposed that they were to make an attack either on Italy or on the Carthaginian part of Sicily; and by Justin, that, while on the voyage, they supposed that they were going on a marauding expedition either to Italy or to Sardinia." The passage in Justin is really stronger than as quoted by Airy; the troops did not realise at the time that it was Africa where they had landed (tunc primum exposito in Africae litore exercitu consilium suum omnibus aperit); they appear to have thought that they were in Italy or Sardinia, and consequently they must have passed through the Straits of Messina, and subsequently kept out of sight of land until Africa was reached.

If, as we believe, Agathocles had really planned events exactly as they turned out, he would have ordered his partisans at Gela to send provision ships directly there was a strong south wind, and he probably gave them to understand that he would come to their assistance, and that there would be a naval battle, in which the provision ships might turn the scale. Agathocles must have had bitter enemies in Gela, as he had just perpetrated an atrocious massacre there, and we may assume that his partisans there were bound to him by self-interest only, and had no idea of being sacrificed to the Carthaginians merely that Agathocles might escape.

Enough of his false plans had been allowed to leak out to the Carthaginians for them to suppose that he was coming out of Syracuse to give battle; it was only at the last moment that the Carthaginians, and perhaps also the men of Gela, realised that he was merely bent on escape from Syracuse. Meanwhile he had allowed his men to think that they were bound for Sardinia. Had they steered south his men would have thought that Agathocles was not acting according to a prearranged plan, but from hand to mouth as best he could. If they steered north his men would have felt the confidence engendered by seeing everything going according to the programme. If Agathocles had laid his plans beforehand, he would probably have collected information as to

currents in the Straits of Messina, and would have known that, in the early afternoon of the day preceding new moon, there is a five-knot current running northwards (Mediterranean Pilot). This current may possibly have contributed materially to his escape, for he seems to have been hard pressed (*ἀνεπιόρτον σωτηρίας ἔτρυχε*). If he went northward, it certainly adds ten miles to the distance he would otherwise have traversed by the time that he saw the eclipse.

P. H. COWELL.

SCIENTIFIC INVESTIGATION IN INDIA.¹

THE Board of Scientific Advice was constituted in the year 1902 by the Government of India as a central authority for the coordination of official scientific inquiry, its object being to ensure that the work of research was distributed to the best advantage, that each investigator employed by Government should confine his researches to the subject with which he was most capable of dealing, and that energy should not be wasted by the useless duplication of work or misdirected by a lack of inter-departmental cooperation. It was, more especially, hoped by the Government that the Board would materially assist it in prosecuting research in those questions of economic or applied science which are of direct practical importance, and thus contribute towards the solution of those problems and matters on which the progressive prosperity of the country, more especially as regards its agricultural and industrial development, so largely depends.

The Board includes the Secretary to the Government in the Department of Revenue and Agriculture, which controls and administers the various scientific and semi-scientific departments, and the heads of those departments, including the Surveyor-General of India, the Director-General of Indian Observatories, the Directors of the Geological and Botanical Surveys of India, the Inspectors-General of Forests, of Agriculture, and of the Civil Veterinary Department.

It advises generally upon the operations of the departments, discusses the programmes of work and investigation of each departmental head, submits annually to Government a general programme of research embodying the proposals of departmental heads in so far as their subjects are to be exclusively dealt with in one department, and its own proposals when two or more departments are to cooperate, and also at the end of the year prepares a review stating briefly the actual results of the work of investigation carried out during the previous year in the scientific departments. The programmes and reviews are communicated through the Secretary of State to the Royal Society, which has selected suitable committees to consider the reports and advise Government chiefly on the scientific problems presented or indicated by the reports.

The necessity for some such arrangement has forced itself upon the Government of India with the rapid extension of scientific investigation during recent years. Private enterprise in such work is practically nil in India, and hence Government has to initiate all scientific investigation that is necessary for the well-being and progress of the Empire. India is at the present stage a country with limited resources, the development of which depends upon the application of modern scientific methods and knowledge to pressing economic problems. The heads of Government can gauge the requirements and initiate departments of inquiry and research, and state for

¹ Report of the Board of Scientific Advice for India for the Year 1904-5

their guidance the general problems with which they have to deal. In order to control the work of their scientific experts, and to direct it on utilitarian and practical lines, they have found out that it is desirable to obtain the opinion of their scientific officers as a whole, and of a final independent scientific authority, viz., the Royal Society. In this way the Government secures the cooperation of its whole body of scientific officers, and also the execution of the work of research in the most efficient and economical manner, and on the practical lines which it desires. Research is, in fact, directed to practical problems that require early solution, and is not wasted on inquiries which are only of importance from the theoretical standpoint.

The report is full of interest. It shows the wide range of problems with which the departments dealt in the year 1904-5, and the results of their work.

A series of experiments was carried out during the year at the Cawnpore experimental farm similar to those at Rothamsted. It was, for instance, ascertained that of the 43.3 inches of rain which fell during the monsoon period of 1904, 5 inches were required to make up the evaporation during the previous dry period; about 9 inches were taken up by evaporation during the monsoon, 4 inches ran off the surface during a very heavy fall in September, and the remainder, 25.7 inches, percolated. The records also established that the amount of percolation is proportionate to the rainfall, and that the quantity of water lost by evaporation from the soil is greater during the four months of the monsoon than during the eight months of the dry season. These results are in general accordance with the Rothamsted records, and hence probably apply to the whole of the plain of northern India.

The Geological Department issued during the year the results of a special investigation into the Dalhousie earthquake of April 4, 1905. It was one of the most destructive earthquakes which has visited India for many years. At least 20,000 human beings are estimated to have perished. The shock was sensibly appreciable over an area of 1,625,000 square miles. The main focus was at a depth of from eighteen to thirty miles below the surface in the Kangra district. The larger waves reached Bombay and Calcutta at almost exactly the same instant. As both places are at the same distance from Kangra, the rate of transmission in both directions was the same, viz. 1.08 miles per second. The seismograph records of Kodaikanal indicated a speed of 1.05 miles per second, and the Japanese seismographs 2.05 miles. The results hence apparently indicate that the earthquake waves travelled out to the east and south at a rate of almost exactly two miles per second.

The report of the Survey Department is especially interesting. The following extract gives a very brief account of the survey work carried out in Thibet during and after the expedition. "Triangulation was executed connecting Lhasa with India, and fixing all prominent peaks; the country was surveyed and charted on a scale of 4 inches to the mile; the valley of the Brahmaputra was surveyed from Shigatze to its source; the Manasarowar lake region was surveyed, as also the source of the Gartok branch of the Indus and the Thibetan source of the Sutlej. The work was carried out in the face of many difficulties in a country with an average elevation of 16,000 feet and a climate of Arctic severity." One of the interesting results of the expedition was to establish that Everest is, so far as is yet indicated by exact measurement, the highest peak in the Himalayas. Sir Richard Strachey, one of the greatest authorities on Himalayan geography, suggested many

years ago the possibility of peaks exceeding 30,000 feet awaiting discovery. All recent investigation appears to establish that it is extremely improbable that there is any peak higher than Everest. It was also ascertained during the Thibetan survey that neither in Nepal nor Thibet is Mount Everest known to the inhabitants by any native name.

The pendulum operations of the Survey of India are furnishing results of great interest. By means of pendulum observations the force of gravity can be ascertained at any place, and as conducted by the survey with the greatest care and delicacy, it can be obtained with a probable error of less than 1 part in 100,000 of its actual value. The earliest observations of this class in India were carried out by Major Basevi upwards of thirty years ago in the western Himalayas. The results of his observations indicated that the force of gravity on the lower Himalayas was considerably less than its value as deduced by geodesists from theory. The deficiency in one case, that of Moré, at an elevation of 15,400 feet, was about 1/2000th part of its theoretical value, and equivalent to the reduction of what may be termed the effective level above the sea of Moré to only 700 feet. It was hence inferred that this deficiency was due to an actual deficiency of matter below, and hence generally that the excess of matter forming the Himalayas is probably, as a whole, compensated by a deficiency of matter in the interior of the earth beneath the mountain mass.

Major Lenox Conyngham recently carried out a lengthened series of pendulum observations. The chief results of his work are that there is a deficiency of gravity (that is, the actual is less than the theoretical value) along and over the outer ranges of the Himalayas. The compensation hitherto assumed to exist as a result of Basevi's measurements is shown by Conyngham's observations to be only partial and not complete. Further south, in the Indo-Gangetic plain, the deficiency disappears and is replaced by an excess. Probably when sufficient data are available it may be possible to formulate a theory of Himalayan structure.

Much valuable work was done during the year in the field of agricultural botany. Amongst the subjects of inquiry was that of the possible deterioration of the jute plant in Bengal. It was ascertained that there is not only no proof of any deterioration, but strong evidence that the plant is now precisely as it was a century and a half ago. The best kinds now, as then, if cultivated liberally, yield excellent crops, and their fibre, if properly extracted, is also excellent. Fraudulent watering in the preparation of the fibre is resorted to with the object of fictitiously increasing its weight for sale. The deterioration of the fibre (not the plant) is due to the fact that the demand for good jute exceeds the supply, and hence that inferior fibre is readily purchased.

As showing the value of the cooperation of the Board of Scientific Advice and the advisory committee of the Royal Society, it is sufficient to mention that they both suggested the necessity for increase of officers in the Geological Department in order to carry out the survey of the geology and mineralogy of Burma. The Government of India accepted the suggestion, and recently sanctioned the addition of four officers to the strength of that department.

The Board is, as shown by the report, doing valuable service in India by coordinating and promoting scientific work, and it is much to be wished that the English Government would adopt some similar plan, and revise the scheme of operations of its chief observatories at Greenwich, Kew, and South Kensington.